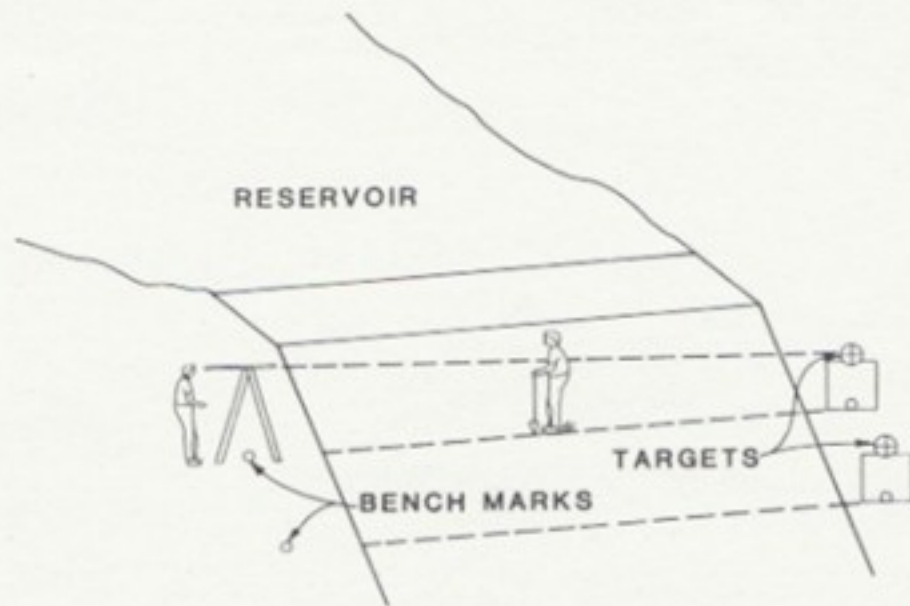


Figure IV-39. Typical Layout Of A Collimation System



TRILATERATION USING ELECTRONIC DISTANCE MEASUREMENTS

Locating a point or triangle by measuring distances is known as the trilateration method. In recent years, the development of EDM (electronic distance measurement) equipment has resulted in significant improvements in trilateration methods. EDM permits the positioning of reference monuments far enough away from the area to be monitored that they will be unaffected by any general movement of the area.

EDM trilateration equipment includes:

- EDM device
- Instrument piers
- EDM targets (reflective measurement points)

The EDM device uses the velocity of electromagnetic radiation to measure distance. The basic principle is to emit a modulated beam of light (infrared light, microwave radiation, or visible light) and observe its reflection from a target reflector. Figure IV-40 depicts a typical trilateration network.

Figure IV-37. Typical Structural Measurement Points
(Continued)

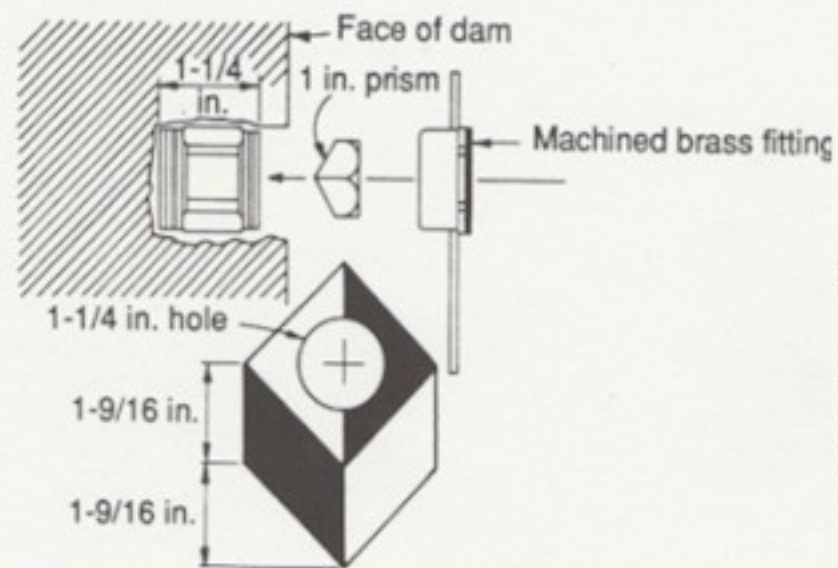
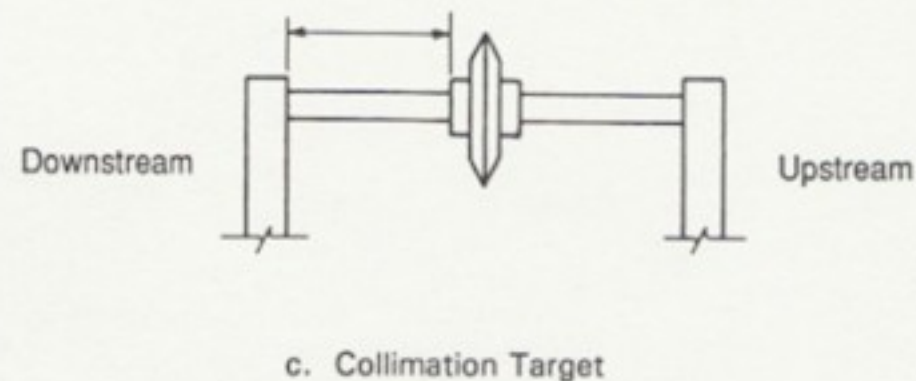
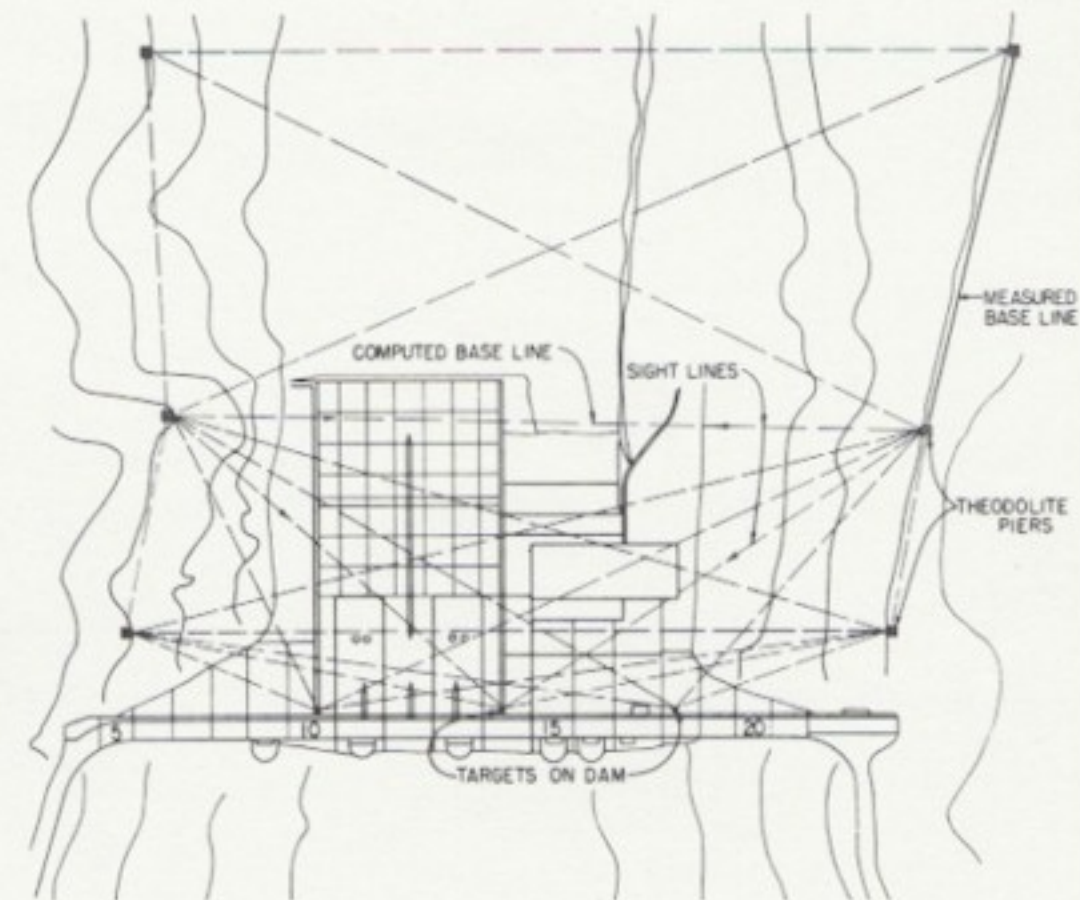


Figure IV-41. Typical Triangulation Network



PRECISION LEVELING

Vertical movements of concrete dams are usually measured by precision leveling techniques from known benchmark elevations to various points on the dam. When such observations are made at relatively regular time intervals, the rate of movement and the total movement can be determined.

A measuring rod is placed at the measurement point, and a survey instrument is used to direct a level beam at the rod. Various leveling devices may be used, including conventional engineer's levels, tilting levels, self-leveling devices, and optical-tooling levels.